A Study Comparing Economic Development and Human Development as Measures of Standard of Living

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Abstract:

There has been much debate as to which measure is best when studying economic development of a nation. Our cross-sectional study of originally 87 and then 150 countries in the year 2015 compares the Human Development Index (HDI) and GDP per capita in regressions with five explanatory variables which have been chosen as comprehensive measures of our interpretation of standard of living: unemployment rate, gross domestic savings rate, fertility rate, household final consumption expenditure, and infant mortality rate. Multiple regression analysis shows that the coefficients of the explanatory variables result in greater changes in GDP per capita rather than HDI. However, the R-squared value of the regression with HDI is higher than that of GDP per capita.

I. Introduction

Economists are constantly exposed to new theories, models, and tools to interpret data and findings, leading to much debate as to which is best or most accurate. A major controversy in the field of developmental economics is in the usage of the Human Development Index (HDI) in measuring the standard of living and the objective well-being of individuals in society, such as decent work for all, economic growth, and increased job opportunities. The component calculation for the Human Development Index has been altered several times since it was first created, and is currently characterized as the geometric mean of life expectancy at birth, expected years of schooling, and the GNI per capita. Another widely used measure of economic development that is competing with HDI is GDP per capita. Advocates of this method claim that HDI is restricting simply to the three factors used to calculate it and looking at GDP per capita allows for a much more open interpretation as it gives insight on income levels, purchasing power parity, and other indicators of economic advancement and development.

This paper focuses on our own interpretation of this common argument. In this study, we engage in a cross-sectional analysis among first 87 and then 150 different countries in the year 2015. We have developed a list of five independent variables which we use in the regressions that were chosen on the basis that they are pivotal to a comprehensive analysis of standard of living in all aspects such as health status, work life, and domestic savings and economic conditions. We first use these five explanatory variables in two different regressions; one with GDP per capita as the dependent variable, and the other with HDI as the dependent variable. Through this analysis we aim to determine which is a better measure of our interpretation of the standard of living. Following the notion that many politicians assume that a strong indicator that a country is moving from developing to developed is increased investment, and also following the Keynesian assumption that savings is equal to investment, we hypothesize that the gross domestic savings rate will have the greatest statistical significance among all our variables. Because of HDI’s components (GNI per capita, life expectancy at birth, and education), we believe that it will be a better measure of standard of living due to these components being more receptive to factors that may represent standard of living that aren’t explained by looking at output per capita. The two dependent variables that we analyze are GDP per capita and HDI, we anticipate that three of our explanatory variables will have a negative correlation with both the independent variables: unemployment rate, fertility rate, and infant mortality rate. On the other hand, we predicted that the remaining two independent variables would have a positive correlation with our dependent variables: domestic savings rate and final household consumption. Our study is based on Sustainable Development Goal #8 which emphasizes decent work for all and economic growth. We incorporate this theme into our paper quite evidently as we are focusing on measuring the human development in societies and its relationship with economic growth and development. Our set of explanatory variables includes factors such as unemployment rate, domestic saving, and household consumption which are directly related to major themes of this sustainable development goal such as the right to decent work, economic growth, and the strengthening of domestic economy and financial institutions. Additionally, in our study we work to determine the best way in which to even measure sustainable economic development. We are making a contribution to this Sustainable Development Goal by providing an analysis on how to best interpret and quantify the progress that has been and contributes to be made towards Goal #8.

II. Literature Review

For many decades, economists have debated between the use of GDP per capita versus the Human Development Index (HDI) as the primary measure of economic development. Many economists today argue that HDI is not an adequate enough measure of economic development and living standards; Grubaugh (2015) further analyzes this argument to make a claim of whether or not HDI is a tool that is worth pursuing. Grubaugh utilizes the Moral-Benito (2012) Bayesian averaging of maximum method to develop 13 "Growth Model" independent variables that are used in regressions against the dependent variable, GDP per capita. The results of this estimation show that holding all else constant, the level of initial GDP per capita is negatively correlated to the rate of growth over the given year. The same 13 independent variables are also now used to regress against the rate of change in HDI over six, five-year periods, as the dependent variable. Results show that generally speaking, the variables that were found to be statistically significant for GDP per capita growth are statistically insignificant in estimating HDI growth. The results gained from this study are consistent with the conditional convergence hypothesis which states that holding all else constant, more developed countries will grow at a slower rate than countries that are in the early stages of development.

Building on Grubaugh, Bhuiyan and Szulga (2017) analyze the micro determinants that classify life satisfaction, a subjective measure of well-being and the quality of life and its relationship to its country's level of economic development. The paper observes 53 different micro variables over 98 different countries between the years of 1989 and 2014. These variables are based on the empirical evidence from subjective well-being regressions as well as significant agreement between researchers. Data was collected by asking respondents to rate their satisfaction with their life on a scale of 1 to 10. In addition to this, demographic, personal economic, personality trait and locus of control data was gathered. Extreme bound analysis is used to process the data and determine the variables that are robust given the controls included in the regression. The standard variables that are chosen for this study are age, employment status, gender, education, marital status, subjective health status, income rank, and number of children. It is concluded that four of these standard variables: health, absolute income, gender, and marital status were found to be robust variables. On the other hand, educational level and number of children were not concluded as robust. Additionally, the variable health has a U-shaped relationship with the level of life satisfaction. Bhuiyan and Szulga also show that the categories of the determinants are universal determinants of life satisfaction throughout most countries. Overall, this paper argues that the number of robust determinants of life satisfaction increases with economic development. This is due to the fact that as countries develop, the general standard of living of the majority of its citizens also rises. This leads to certain more basic needs being met and being replaced by other needs.

Additionally, Angus Deaton (2010) discusses the mechanisms used to discuss economic development and common trends/theories that have been used to determine economic growth and development. Deaton specifically talks about the connection between saving and growth, the influences of commodity prices and the "puzzles" that arise from making connections between income and food consumption. The method he chooses to examine these topics is the hypothetico-deductive method that was designed by Nancy Cartwright (2007). Deaton primarily examines the theory and simple observation of savings and growth where he mentions important contributions to the theory. These include Arthur Lewis (1954), who stated how the saving and capital accumulation are the center point of economic development, and Franco Modigliani and Richard H. Brumberg (1954) who developed the life-cycle theory of saving. All these authors made these contributions in 1954, and Modigliani furthered his previous work in the late 60's and early 70's to include implications to international data. In doing so, he concluded that young people save more than the older segment of the population and when populations grow, there are more people that save and those who save, with economic growth, are richer than those who don't, so their saving will offset those who do not. All of this will lead to increases in both population growth and the national saving rate. He even further states that savings rate and the level of development should be independent of each other; the relationship should be a concave function where the parameters are determined by the ratio of the retirement span to the work span. Robert Solow (1956), with whom the Solow Model in economic development is named after, reached a similar conclusion after his work that even though a higher savings rate can lead to higher growth in the short-run, that in the long-run the growth rate isn't dependent on it. In the 1990's, there came challenges to the life-cycle theory of saving, specifically from Christopher D. Carroll and Lawrence H. Summers (1991) who stated that the "cross-sectional age profiles of consumption should rotate clockwise with the rate of economic growth" and their empirical observations showed otherwise. Deaton argues that even though there were aspects of the previous assumption that proved inconsistent with later data, the underlying theory may still hold some truth. In his conclusion he discusses how, even when falsification are proven in regards to previously accepted theories, that we can still learn from them. We learn what "part of the theory was wrong, which supplementary assumptions need to be modified, or under what circumstances the theory does not hold".

Our study aims to build off of these papers in order to see if our own set of similar determinants of economic growth produce consistent results. Our paper is unique in the sense that we have established our own set of explanatory variables that were chosen to analyze on the premise that they fit our definition of all components of standard of living. We have chosen a wide array of elements to analyze ranging from determinants of health status, to determinants of employment, and determinants of economic status. Through this we will determine whether GDP per capita or the Human Development Index is a better measure of our understanding of the standard of living. Through this paper we are taking a stance on supporting or discrediting HDI and providing a new and comprehensive interpretation of standard of living to do that with.

III. Data

A. Source of Data

The data for most of the variables were from the World Bank Database which holds large aggregates of data for most countries and dependencies in the world. The Human Development Index data was taken from the United Nations Human Development Reports. We began with over 230 countries and dependencies. However, we then decided to solely look at members of the United Nations as this would eliminate dependencies and possibly give us more open information available. After removing countries with missing data points for the variables we wished to look at, the number of countries left were 87 (see appendix part B). We chose the year 2015, as the year to get country data from that required a time variable, for consistency and it provided the most available data as 2016 seemed incomplete at this point.

B. Description of Variables

Within this study there are two dependent variables that are looked at: Gross Domestic Product per capita (*gdpcap*)[1] [in current USD $] and the Human Development Index (*hdi*). GDP per capita is looked at when discussing average income levels as well as standard of living across countries. The Human Development Index is used to map progress of human development in ways that GDP per capita does not. GDP per capita is a well-known estimator when looking at standard of living. When looking at economic development we find it important to look at impacts to standard of living and therefore use it as our dependent variable for a regression model to compare explanatory variables to the dependent variable, *hdi*, to see which is a better indicator of development in our model. These two variables are accompanied

[1] GDP per capita is used in terms of current U.S. Dollars instead of Purchasing Power Parity (PPP) as we would have lost more observations.

by independent (explanatory) variables that are used look and see whether these explanatory variables have a better impact towards HDI or GDP per capita.

Explanatory Variables:

ue

Unemployment Rate for 2015; This describes individuals who are unemployed and actively seeking work as a part of the total labor force in that country. This was an important variable to look at as a country close to full employment may be an indicator of prosperity and growth within the country that could help when looking at overall development.

domsav

Gross Domestic Savings (as a % of GDP) for 2015; The variable looks at subtracting final consumption expenditure from gross domestic disposable income. This leaves us with the summation of savings from: personal, government and private. Looking at the overall domestic savings percentage, an idea of the country's steady state in terms of its ability to adapt to financial changes. A higher savings percentage can indicate that a lower proportion of income is going towards consumption and having financial freedom can help with satisfaction and overall standard of living.

fertr

Fertility Rate (per woman) in 2015; This rate looks at the average number of children born per woman in the given country. This factor is important to look at as it is often compared with GDP per capita in terms of income and how a higher fertility rate may be potentially associated with a lower GDP per capita for that country. This comparison is looked at further and is an important part of economic development.

housecons_gr

Household final consumption expenditure per capita growth (annual %) in 2015; This variable looks at an annual growth model for household consumption of goods and services that could be considered needs or wants. This variable is per capita so it shows the percentage growth in terms of the population of each country. A positive growth rate could help explain if on average the people of that country are spending less on needed goods and more on wanted goods.

infant_mort

Infant Mortality (per 1000 live births); This is an indicator of quality of life and how the country overall is doing in terms of healthcare. By looking at this rate, it gives us part of the picture of the environment the country has for its residents and how this will impact other factors of well-being.

The table below summarizes our independent and dependent variables:

Variable	Name	Description	# of Obvs.	Year	Source
lgdpcap	Gross Domestic Product per Capita (log scale)	The measure of total output of a country divided by the country's population in current U.S. dollars	87	2015	World Bank
hdi	Human Development Index	A measure of economic development in a nation based on the geometric mean of life expectancy at birth, expected years of schooling, and GNI per capita	87	2015	UNDP
ue	Unemployment Rate	The ratio of the percentage of unemployed individuals actively seeking employment to the total labor force	87	2015	World Bank
domsav	Gross Domestic Savings (as a % of GDP)	The summation of personal, government, and private savings	87	2015	World Bank
fertr	Fertility Rate (per woman)	The average number of children born per woman in the given country	87	2015	World Bank
housecons_gr	Household final consumption expenditure per capita growth (annual %)	Derived from the annual growth model for household consumption of goods and services	87	2015	World Bank
infant_mort	Infant Mortality (per 1000 live births)	An indicator of quality of life and how the country is generally doing in terms of healthcare	87	2015	World Bank

Figure 1. Variable Summary

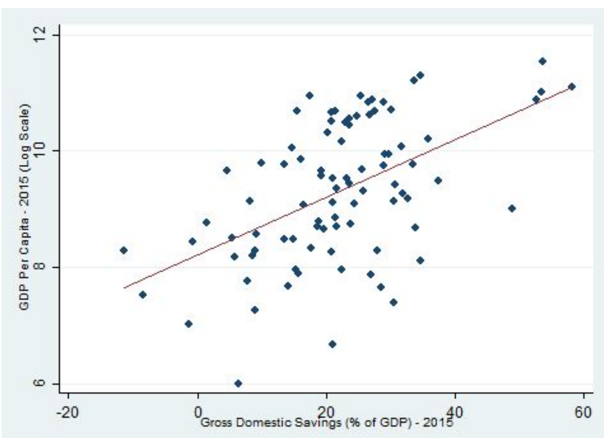
C. Summary Statistics

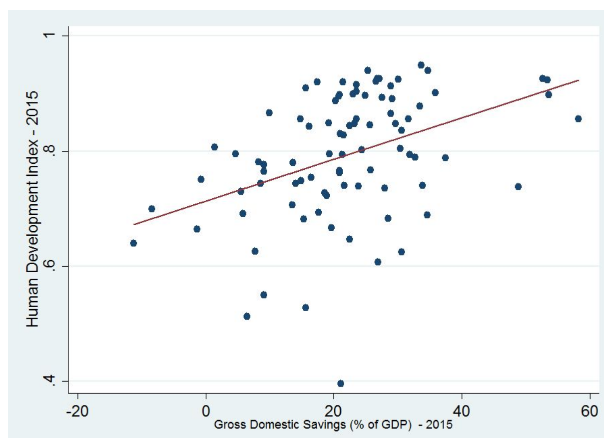
Variable	Observations	Mean	Standard Dev	Minimum	Maximum
lgdpcap	87	9.31	1.20	5.99	11.53
hdi	87	0.79	0.11	0.40	0.95
ue	87	8.19	5.65	0.16	26.26
domsav	87	22.12	12.57	-11.28	58.26
fertr	87	2.02	0.83	1.20	6.10
housecons_gr	87	1.38	3.9	-19.40	8.20
infant_mort	87	12.06	14.3	1.50	85.00

Figure 2. Summary Statistics

The summary statistics above help us to understand the data we are looking at as a whole. For instance, the average HDI value for the countries is 0.79, which is considered high human development. The mean log of GDP per capita is 9.31 which closer to the maximum, 11.53, where the minimum was 5.99. There are also some countries that have a negative gross domestic savings rate which can be seen from the minimum. Also, the data shows there is a wide range of infant mortality rates per 1000 live births. The mean for infant mortality is 12.06, but there is some deviation that exists along with a maximum of 85.

After collecting the data above, we take a look at each of the two dependent variables as they compare to a single independent variable, gross domestic savings rate (*domsav*). The scatterplots are shown below and it can be seen that generally they both have a weak positive correlation, with the correlation with GDP per capita only slightly better. Gross domestic savings rate is just one of the explanatory variables that will be used to better explain the dependent variables. With more relevant variables, we can expect to see a better correlation.





D. Gauss–Markov Assumptions

1. Linear in Parameters – The models are simple and multiple regressions that are linear in parameters.

2. Random Sampling – The population for this survey, originally, is 87 countries around the world. The number of observations were limited to this number as they were the only countries that had values for all variables within the dataset. The population does not include any dependencies.

3. No perfect collinearity – The model does not have any perfect collinearity and therefore holds this assumption. Looking at the correlation matrix below, there is some high collinearity between infant mortality rate and fertility rate which is expected and does not hurt the assumption.

	gdpcap	ue	domsav	fertr	housec~r	infant~t	hdi
gdpcap	1.0000						
ue	-0.2000	1.0000					
domsav	0.5381	-0.3980	1.0000				
fertr	-0.3133	-0.2257	-0.1871	1.0000			
housecons_gr	0.0494	-0.0927	0.2880	-0.1129	1.0000		
infant_mort	-0.4623	-0.1374	-0.2370	0.8605	-0.1496	1.0000	
hdi	0.7379	0.0092	0.4107	-0.7181	0.1245	-0.8598	1.0000

4. Zero Conditional Mean – The expected error value to pass this assumption is 0. However, it isn't guaranteed when looking at data. With including data points for 87 different countries this helps to make the assumption to be as close to 0 as possible. With the more independent variables, the model moves closer to its true distribution.

5. Homoscedasticity – The assumption is present that the error holds the same variance irrespective of any independent variables.

IV. Results

A. Simple Linear Regressions

Model 1:

$$\log(gdpcap) = \beta_0 + \beta_1 domsav + u$$

$$\log(\widehat{gdpcap}) = 8.2164 + 0.0495 domsav$$

Model 2:

$$\text{hdi} = \beta_0 + \beta_1 domsav + u$$

$$\widehat{hdi} = 0.7128 + 0.0036 domsav$$

Because we are wanting to compare human development and economic development to see which one is a more accurate measure of standard of living, we looked at two simple regressions and used the same explanatory variable in each. Since GDP per capita measures output per person, which can be used to represent the average productivity levels of a country, and GNI per capita is used calculate the Human Development Index, we would assume that as general productivity increases in a country, income would also rise. In the discussions of development, a common assumption is that as a country grows economically and its population becomes more well off, their disposable income will increase thus allowing them to save more. A widely used indicator to show this is gross domestic savings rate (as a % of GDP), which is our explanatory variable *domsav*. That is why we chose this explanatory variable to be in both of our simple regressions, so that we could compare how much both GDP per capita and HDI change when gross domestic savings increases. We run log of GDP per capita when conducting all the regressions in order to help with scaling since the values are so much larger than those of HDI. The regressions show that as the gross domestic savings rate increases by one percent, GDP per capita increases by approximately 4.95 % and HDI increases by 0.0036 points. Our hypothesis is that HDI is a better representation of standard of living, but the results of our simple regression show that, when looking at the gross domestic savings rate, that GDP per capita is more affected. This is further shown by the R-squared values from each regression. The R-squared value for GDP per capita is 0.269 and the value for HDI is 0.169. There may only be an approximate 10% difference in how much the gross domestic savings rate describes the variance for each y-variable, but our data shows that it accounts for slightly more variance in GDP per capita.

B. Multiple Regressions

Model 3:

$$\log(gdpcap) = \beta_0 + \beta_1 domsav + \beta_2 ue + \beta_3 fertr + \beta_4 housecons\_gr + \beta_5 infant\_mort + u$$

$$\log(\widehat{gdpcap}) = 8.7578 + 0.0381 domsav + 0.0018 ue + 0.2301 fertr - 0.0222 housecons\_gr - 0.0612 infant\_mort$$

Model 4:

$$\text{hdi} = \beta_0 + \beta_1 domsav + \beta_2 ue + \beta_3 fertr + \beta_4 housecons\_gr + \beta_5 infant\_mort + u$$

$$\widehat{hdi} = 0.8149 + 0.002 domsav + 0.0002 ue + 0.0092 fertr - 0.0019 housecons\_gr - 0.0068 infant\_mort$$

In order to make a more inclusive analysis, we ran multiple regressions with the rest of our explanatory variables: unemployment rate, growth in household consumption per capita, infant mortality rate, and fertility rate. Together these provide an encompassing representation of standard of living. In regards to this model, an increase in the gross domestic savings rate by one percent will increase GDP per capita by approximately 3.81% and increase the Human Development Index by 0.002 points. Running the multiple regression showed that the gross domestic savings rate has less of an effect on both GDP per capita and HDI than it did in the simple regression which may be due to the strength of the coefficients of the other explanatory variables. Unemployment was one of them and when it increases by one percent, then GDP per capita increases by around 0.18% and the Human Development Index decreases by 0.0002. Unemployment had the lowest coefficient value for HDI and GDP per capita among all the variables and its low value means that is has close to zero effect on the change in either one of these variables. Even though GNI per capita is used to calculate HDI, the low correlation could be a result of a possible trend of income inequality on average; the high incomes of a segment of the population could offset the drop in income per capita that would result in those who are unemployed, thus bringing the effect closer to zero. Furthermore, fertility rate exhibited the largest percent change for the GDP per capita regression, with a rise of approximately 23.01% with an increase in fertility of one. Its effect on HDI was raising it by 0.0092. Fertility and GDP per capita would be expected to have a negative correlation, but our result is most likely due to the fact that when gathering our data, we couldn't include some of the more lesser developed countries because there wasn't enough data available. Its low effect on HDI means that, even if there is an effect on the GNI, it is not large compared to the other two factors that are used to calculate the dependent variable. Additionally, the growth in household consumption per capita had even less of an effect on HDI with it only changing by -0.0019. This could be due to the fact that household consumption may not a large correlation with GNI, life expectancy, or education based on our data. Growth in household consumption did, however, provide an interesting relationship with GDP per capita. As it increases by one percent, GDP per capita decreases by about 2.22%. This negative relationship could be the result from the disposable income that populations receive not being spent within their own domestic economy. Also, infant mortality rate had less surprising of a correlation, with GDP decreasing by about 6.12% with an increase of mortality by one. Its result on HDI is decreasing it by 0.0068. This would be due to its tie with life expectancy at birth. Overall, the coefficients of our explanatory variables cause greater changes in GDP per capita than HDI, but the R-squared value for the regression with HDI is 0.1824 higher than the value for the regression with GDP per capita.

C. Statistical Inference

After running the multiple regressions, we conducted both t- and p-tests to see which of the explanatory variables were significant to our changes in our dependent variables. The results can be seen in the table below.

Independent Variable	**P>|t| (GDP per capita)**	**P>|t| (HDI)**	**t-value (GDP per capita)**	**t-value (HDI)**	**Confidence Interval (GDP per capita)**	**Confidence Interval (HDI)**
domsav ***	0	0	4.83	3.82	[0.022-0.538]	[0.001-0.003]
ue	0.919	0.872	0.10	-0.16	[-0.032-0.036]	[-0.003-0.002]
fertr	0.258	0.504	1.14	0.67	[-0.172-0.632]	[-0.018-0.036]
housecons_gr	0.326	0.218	-0.99	-1.24	[-0.067-0.022]	[-0.005-0.001]
infant_mort ***	0	0	-5.27	-8.63	[-0.084-(-0.038)]	[-0.008-(-0.005)]

Observations: 87
Degrees of Freedom: 81

***** Significant at 1%**
**** Significant at 5%**
*** Significant at 10%**

Figure 3. Inference Table

For each, the tested null hypothesis was H_0: $\beta = 0$. With 81 degrees of freedom, the critical value for our t-test was between 1.987 (for 60 degrees of freedom) and 2 (for 90 degrees of freedom). Of all the t-values of our explanatory variables, only two, gross domestic savings rate and infant mortality rate yielded values greater than the critical values when tested against both dependent variables allowing us to reject the null hypothesis. When looking at the p-values, that test yielded the same result as only those two variables having values below the 1%, 5%, and 10% levels of significance. So overall, both tests displayed that out of our five chosen explanatory variables, only the gross domestic savings rate and infant mortality proved to be significant and were at the 1% level.

By looking at only the explanatory variables that proved to be significant, we obtain new multiple regression equations:

Model 5:

$$\log(gdpcap) = \beta_0 + \beta_1 domsav + \beta_2 infant\_mort + u$$

$$\log(\widehat{gdpcap}) = 9.0548 + 0.0288 domsav - 0.044 infant\_mort$$

Model 6:

$$\beta_0 + \beta_1 domsav + \beta_2 infant\_mort + u$$

$$\widehat{hdi} = 0.8136 + 0.0018 domsav - 0.0061 infant\_mort$$

Focusing on just these two variables, we are able to go from 87 observations to 150 thus generating results that are a better representation of all the countries worldwide. The summary statistics can be seen in the table below.

Variable	Observations	Mean	Standard Dev	Minimum	Maximum
lgdpcap	150	8.57	1.49	5.72	11.53
hdi	150	0.70	0.16	0.35	0.95
domsav	150	18.62	16.02	-66.92	58.26
infant_mort	150	23.37	21.92	1.7	91.2

Figure 4. Summary Statistics II

The regression estimate table for all of our models can be find in the table below.

Independent Variable	Model 1 (SLR GDP)	Model 2 (SLR HDI)	Model 3 (MLR GDP)	Model 4 (MLR HDI)	Model 5 (MLR Significant GDP)	Model 6 (MLR Significant HDI)
domsav	0.0495 *** (0.0089)	0.0036 *** (0.001)	0.0381 *** (0.008)	0.002 *** (0.001)	0.0288 *** (0.0047)	0.0018 *** (0.0004)
ue	-	-	0.0018 (0.0171)	-0.0002 (0.0012)	-	-
fertr	-	-	0.2301 (0.202)	0.0091 (0.0136)	-	-
housecons_gr	-	-	-0.0222 (0.0224)	-0.0019 (0.0015)	-	-
infant_mort	-	-	-0.0612 *** (0.0116)	-0.0068 *** (0.001)	-0.044 *** (0.0034)	-0.0061 *** (0.0003)
intercept	8.2164 (0.225)	0.7128 (0.022)	8.7578 (0.453)	0.8149 (0.0306)	9.0548 (0.1581)	0.8136 (0.012)
# of Obvs.	87	87	87	87	150	150
R-square	0.2691	0.1687	0.6076	0.79	0.7048	0.8553

Figure 5. Regression Estimates

Models 5 and 6, which represent the multiple regressions with only the significant explanatory variables, yield the highest R-squared values among all of our models.

IV. Extensions

A. Robustness Tests

To test whether the insignificant variables of *ue, fertr and housecons_gr* are jointly significant, we conducted an F-test.

Using the unrestricted models:

$$log(gdpcap) = \beta_0 + \beta_1 domsav + \beta_2 ue + \beta_3 fertr + \beta_4 housecons\_gr + \beta_5 infant\_mort + u$$

$$hdi = \beta_0 + \beta_1 domsav + \beta_2 ue + \beta_3 fertr + \beta_4 housecons\_gr + \beta_5 infant\_mort + u$$

and the null hypothesis of H_0: $\beta_2 = 0,\ \beta_3 = 0,\ \beta_4 = 0$ we run the F-test with the restricted model:

$$log(gdpcap) = \beta_0 + \beta_1 domsav + \beta_5 infant\_mort + u$$

$$hdi = \beta_0 + \beta_1 domsav + \beta_5 infant\_mort + u$$

The critical value of $F_{3,81}$ is between 2.76 and 2.71. Using the R-squared values from the unrestricted and restricted models, the F-statistic can be calculated by subtracting the restricted R-squared from the unrestricted R-squared divided by the degrees of freedom in the numerator (3) all over one minus the unrestricted R-squared divided by the degrees of freedom of the unrestricted (81). The F-statistic for *lgdpcap* is 0.7431 and the statistic for *hdi* is 0.6814. Because both of these are less than the critical value, we fail to reject null hypothesis meaning that the unemployment rate, fertility rate, and household consumption growth per capita are not jointly significant at the 5% level. This result further verifies that those three variables are not important in explaining the change in GDP per capita and HDI. Knowing that they are not jointly significant provides more support for us moving forward with a model containing only two explanatory variables in order to capture more observations.

B. Functional Form

In our analysis we used a log-level model in which our dependent variable, log (*gdpcap*), was compared against linear level independent variables. We chose to do this due to the fact that GDP per capita is a positive dollar amount and the usage of natural logs helps to remove the impacts that scaling has on units of measurement. Additionally, using log (*gdpcap*) satisfies the CLM assumptions and helps to secure homoscedasticity. Once we evaluated the significant variables in our regression, gross domestic savings rate and infant mortality rate, we restricted our model and our sample size went up to 150 countries. We then looked to see if the two significant variables would benefit from a different functional form. We concluded that gross domestic savings rate squared was not significant at any level, however, infant mortality rate squared was significant at the 1 percent level. From this we can deduce that the effect that infant mortality has on our dependent variables is dependent on the value of infant mortality, thus implying that the marginal effect of the explanatory variable is not constant. Based on these findings and implications, it is proven that the linear regression was mis-specified and that the functional form was incorrect.

Additionally, when looking into the functional form for infant mortality rate, we find that the coefficient on infant mortality rate is negative, however, the coefficient on infant mortality rate squared is positive. This is true for the regression with HDI as well as GDP per capita. This implies that our turning point on the quadratic function is a minimum point instead of a maximum point. This can be further interpreted to conclude that the impact of the change in infant mortality rate on HDI and GDP per capita is larger at lower levels of infant mortality than higher levels of infant mortality.

The following scatter plots show the correlation between HDI and GDP per capita and our two significant variables, infant mortality rate and gross domestic savings rate, with their respective appropriate functional form. We chose to use the quadratic functional form for infant mortality rate as it fit best with our data, however, gross domestic savings rate is left as linear because the variable was not significant in the quadratic form.

The functional form analysis table below again shows that the quadratic functional form for gross domestic saving rate (domsav) is not significant at any level for either dependent variable. On the other hand, the quadratic functional form for infant mortality (infant_mort) is significant up to 1 percent.

Variable	F.F. 1 HDI (domsav)	F.F.2. HDI (infant_mort)	F.F.3. GDP (domsav)	F.F.4. GDP (infant_mort)
domsav	0.005417*** (0.0007937)	-	0.511963*** (0.0069236)	-
$domsav^2$	0.0000108 (0.0000176)	-	0.000248 (0.0001533)	-
infant_mort	-	-0.0124154*** (0.0006579)	-	-0.1224593*** (0.0095015)
$infant\_mort^2$	-	0.0000823*** (9.05e-06)	-	0.0009917*** (0.0001307)
intercept	0.596344 (0.0171549)	0.9096305 (0.0083591)	7.461719 (0.1496392)	10.41065 (0.1207332)
# of Observations	150	150	150	150
R-Square	0.3170	0.8919	0.3859	0.7335

Figure 6. Functional Form

C. Dummy Variables

Since our observations are countries, we believed it would be important to look at the differences between developed and developing countries. Using the World Bank categorization for the 2015 fiscal year we put countries in the high-income economies category as developed countries. For developing countries, we used the low-income economies, low-middle income economies, and upper-middle income economies. These category classifications are made by cut-offs by the World Bank using Gross National Income (GNI) per Capita. Out of the 150 countries, it was found that 48 were considered developed while 102 were considered developing.

<u>Developed Model 1 & 2</u>

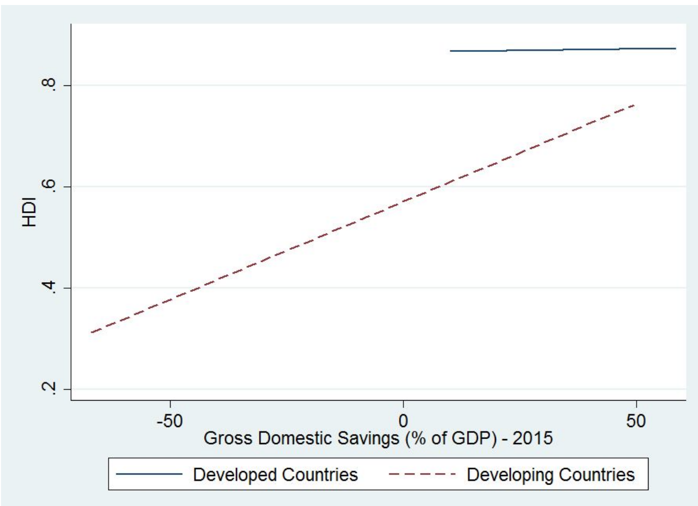
$$\log(gdpcap) = \beta_0 + \beta_1 domsav + \beta_2 infant\_mort + \beta_3 infant\_mort^2 + \beta_4 developed + u$$

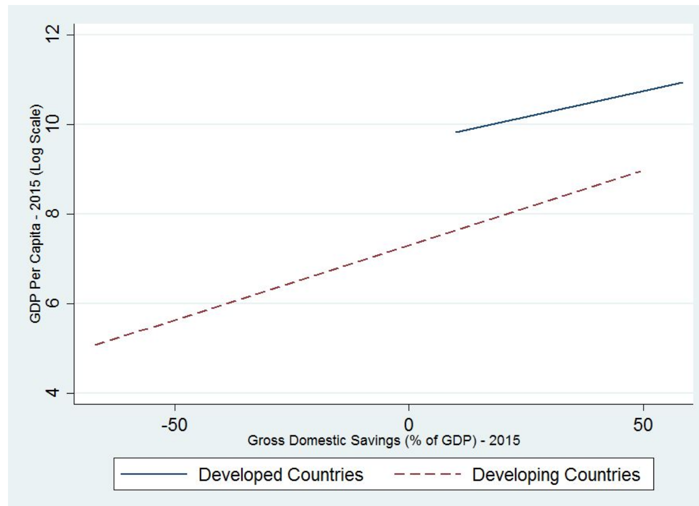
$$\log(\widehat{gdpcap}) = 8.9090 + 0.0209 domsav - 0.0672 infant\_mort + 0.0004 infant\_mort^2 + 1.0739 developed$$

$$\text{hdi} = \beta_0 + \beta_1 domsav + \beta_2 infant\_mort + \beta_3 infant\_mort^2 + \beta_4 developed + u$$

$$\widehat{hdi} = 0.8272 + 0.0013 domsav - 0.0095 infant\_mort + 0.00005 infant\_mort^2 + 0.0539 developed$$

Creating a dummy variable of *developed* (developed country == 1 and developing country== 0) we used this in our regression models. By running the regressions, it is seen that *developed* is significant at the 1% level for both dependent variables (shown in table). Also, our R-squared figures for both dependent variables improved to explain more of the variance than in Model 5 and 6. This allows us further to use the dummy variable to see how developed and developing countries compare in the dataset.





Earlier in the paper the simple regression with the variable for gross domestic savings (*domsav*) was used. Above, it is used again but showing the linear fit lines for both developed and developing. For *hdi* and *lgdpcap* we look at the intercept shift for the developed dummy variable. It shows that developed countries see higher levels of their hdi and *lgdpcap* when compared to developing countries. The shift of the intercept helps to graphically demonstrate the gap between the developed variable. For *hdi*, the developed fit line appears much flatter than the developing fit line as the hdi of developed countries in the data set are concentrated at the higher rate and thus the graphically disproportion is shown.

Variable	All (HDI)	All *(GDP)*	Developed (HDI)	Developed (GDP)	Developing (HDI)	Developing (GDP)
domsav	0.00130*** (0.0002)	0.0209*** (0.0034)	0.0008* (0.0004)	0.0278*** (0.0067)	0.0014*** (0.00003)	0.0187*** (0.0040)
infant_mort	-0.0095*** (0.0007)	-0.0672*** (0.0094)	-0.0145 *** (0.00232)	-0.1545 *** (0.0317)	-0.0093*** (0.0008)	-0.0652*** (0.0101)
infant_mort²	0.0005*** ($9.2x10^{-6}$)	0.0004*** (0.0001)	0.0001*** (0.00003)	0.0018*** (0.0005)	0.0005*** ($1.0x10^{-5}$)	0.0004*** (0.0001)
developed	0.0539*** (0.1175)	1.0739*** (0.1500)	-	-	-	-
Intercept	0.8271 (0.0131)	8.9090 (0.1679)	0.9138 (0.0151)	10.1175 (0.2414)	0.8240 (0.0156)	8.9401 (0.1869)
# of Obvs.	150	150	48	48	102	102
R-Square	0.9227	0.8511	0.7388	0.4476	0.8589	0.6689

Figure 7. Regression Estimates II

Investigating further we looked at running the regression models but only using the observations in either the developed country or developing country group. From the table above, the significance levels stayed at 1% for all the variables except for gross domestic savings rate (*domsav*) in the *hdi* regression when only looking at developed countries where it moved to the 10% level. This may be explained by the fact that the developing countries were classified by three income groups while developed countries were only classified in a high-income economies category. Within the developed countries the fact that they are in the group shows that GNI does not differ too much between them which leads to the decrease in the significance level. As for R-squared values, three of the regression models had values lower than they were in Model 5 and 6. The one regression that had a greater R-squared was when looking only at developing countries in the *hdi* model. The value was barely higher and had the ability to explain more of the variance because developed countries made up roughly 70% of the dataset based on the World Bank's classifications. It's interesting to see the impact that the developed variable had on the model and how inferences can be made on greater understandings of what makes up standard of living.

V. Conclusion

Our goal from conducting this research was to test and see the ability of both GDP per capita and the Human Development Index to measure standard of living. Of the two, we predicted that HDI would be a better measure because we believed its components (GNI per capita, life expectancy at birth, and education) would make it more receptive to changes in indicators that are used to represent standard of living. Of the explanatory variables we chose to represent these indicators, we hypothesized that the gross domestic savings rate would prove to have the highest statistical significance. Our results show that, based on our data, the gross domestic savings rate as well as the infant mortality rate had the highest statistical significance in explaining the changes in both GDP per capita and HDI across the 150 countries. When looking at just these two explanatory variables, our results showed that they explained a greater variance in the change in HDI than in GDP per capita. This is shown in the R-squared value which was 0.7048 for GDP per capita and 0.8553 for HDI. When we further looked to see if the results were similar among developed and developing countries, both the gross domestic savings rate and the infant mortality rate were still significant in explaining the changes in both GDP per capita and HDI among the developed countries and among the developing countries. As before, these variables accounted for more of the variance in HDI as compared to GDP per capita.

Based off of these results, it would appear that both gross domestic savings rate and the infant mortality rate affected HDI more. However, it is not enough to definitively state that HDI is a better measure of standard of living. Of the five explanatory variables we chose, only two proved to be statistically significant which doesn't provide enough indicators to accurately represent standard of living. Their higher R-squared values for HDI compared to GDP per capita can possibly be attributed to their correlation with two of the factors that make up HDI, GNI per capita and life expectancy at birth. When we analyzed the effect of the variables on whether the country was developed or developing, we only ran these two variables because going back to the unrestricted model would have dropped our observations by 63. In doing so we would have lost more countries that would be classified as developing. By foregoing the other explanatory variables in order to have more observations, we are, however, losing the possibility of observing whether the other variables were significant when explaining the changes among the developed and developing countries in the first list of 87. This points to the complexity that can arise when trying to measure or even calculate standard of living. Even though the R-squared values were high for HDI, there are more variables that we could take out of the unobserved "u" term of our equation. There is also the possibility that the variables we did choose to represent standard of living were not the most accurate. We could have looked at other variables that maybe would have proved to also be significant and allowed our observations to be above 87. Based just on our data set and chosen variables, our hypothesis about HDI being a more effective measure may or may not be something we can obtain from our results, but our hypothesis about the gross domestic savings rate being a significant value proved to be true.

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VII. Appendix

Part A: STATA Outputs

. summ

Variable	Obs	Mean	Std. Dev.	Min	Max
name	0				
gdpcap	87	20251.42	21382.22	401.8576	101909.8
ue	87	8.187023	5.6461	.16	26.26
domsav	87	22.12263	12.56837	-11.27665	58.25912
fertr	87	2.02069	.8329183	1.2	6.1
housecons_gr	87	1.38046	3.905328	-19.4	8.2
infant_mort	87	12.06322	14.35269	1.5	85
hdi	87	.7928736	.110801	.396	.949

Figure 1. Summary of simple statistics for variables

. regress hdi domsav

Source	SS	df	MS
Model	.178116937	1	.178116937
Residual	.87769269	85	.010325796
Total	1.05580963	86	.012276856

Number of obs	=	87
F(1, 85)	=	17.25
Prob > F	=	0.0001
R-squared	=	0.1687
Adj R-squared	=	0.1589
Root MSE	=	.10162

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
domsav	.003621	.0008718	4.15	0.000	.0018875	.0053544
_cons	.7127683	.0221514	32.18	0.000	.6687254	.7568113

Figure 2. Simple regression of hdi (dependent) and domsav (independent)

. regress lgdpcap domsav

Source	SS	df	MS
Model	33.3147062	1	33.3147062
Residual	90.4907175	85	1.06459668
Total	123.805424	86	1.43959795

Number of obs	=	87
F(1, 85)	=	31.29
Prob > F	=	0.0000
R-squared	=	0.2691
Adj R-squared	=	0.2605
Root MSE	=	1.0318

lgdpcap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
domsav	.049521	.0088525	5.59	0.000	.03192	.0671221
_cons	8.216438	.2249221	36.53	0.000	7.769232	8.663643

Figure 3. Simple regression of lgdpcap (dependent) and domsav (independent)

. regress lgdpcap domsav ue fertr housecons_gr infant_mort

Source	SS	df	MS
Model	75.2296323	5	15.0459265
Residual	48.5757913	81	.599701127
Total	123.805424	86	1.43959795

Number of obs	=	87
F(5, 81)	=	25.09
Prob > F	=	0.0000
R-squared	=	0.6076
Adj R-squared	=	0.5834
Root MSE	=	.7744

lgdpcap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
domsav	.0381174	.0078946	4.83	0.000	.0224097	.0538251
ue	.0017517	.0171214	0.10	0.919	-.0323144	.0358179
fertr	.2300595	.2019879	1.14	0.258	-.171833	.631952
housecons_gr	-.0221655	.0224214	-0.99	0.326	-.066777	.0224459
infant_mort	-.061153	.0115952	-5.27	0.000	-.0842239	-.0380821
_cons	8.757796	.4528372	19.34	0.000	7.856792	9.6588

Figure 4. Multiple Regression against lgdpcap (dependent)

. regress hdi ue domsav fertr housecons_gr infant_mort

Source	SS	df	MS
Model	.834066914	5	.166813383
Residual	.221742713	81	.002737564
Total	1.05580963	86	.012276856

Number of obs	=	87
F(5, 81)	=	60.93
Prob > F	=	0.0000
R-squared	=	0.7900
Adj R-squared	=	0.7770
Root MSE	=	.05232

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ue	-.0001874	.0011568	-0.16	0.872	-.0024891	.0021142
domsav	.0020398	.0005334	3.82	0.000	.0009785	.0031011
fertr	.0091623	.0136471	0.67	0.504	-.0179911	.0363157
housecons_gr	-.0018789	.0015149	-1.24	0.218	-.004893	.0011353
infant_mort	-.0067585	.0007834	-8.63	0.000	-.0083172	-.0051997
_cons	.8148909	.0305954	26.63	0.000	.7540155	.8757662

Figure 5. Multiple regression against hdi (dependent)

```
. regress lgdpcap domsav infant_mort

      Source |       SS           df       MS      Number of obs   =       150
-------------+----------------------------------   F(2, 147)       =    175.51
       Model |  231.903554         2  115.951777   Prob > F        =    0.0000
    Residual |  97.1191571       147  .660674538   R-squared       =    0.7048
-------------+----------------------------------   Adj R-squared   =    0.7008
       Total |  329.022711       149  2.20820611   Root MSE        =    .81282

------------------------------------------------------------------------------
     lgdpcap |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      domsav |   .0288303   .0046945     6.14   0.000     .0195529    .0381078
 infant_mort |  -.0439707   .0034306   -12.82   0.000    -.0507504    -.037191
       _cons |   9.054755   .1580578    57.29   0.000     8.742396    9.367114
------------------------------------------------------------------------------
```

Figure 6. Multiple regression only significant against lgdpcap (dependent) - 150 obvs.

```
. regress hdi domsav infant_mort

      Source |       SS           df       MS      Number of obs   =       150
-------------+----------------------------------   F(2, 147)       =    434.43
       Model |  3.32543473         2  1.66271737   Prob > F        =    0.0000
    Residual |  .562616838       147  .003827325   R-squared       =    0.8553
-------------+----------------------------------   Adj R-squared   =    0.8533
       Total |  3.88805157       149  .026094306   Root MSE        =    .06187

------------------------------------------------------------------------------
         hdi |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      domsav |   .0017711   .0003573     4.96   0.000      .001065    .0024772
 infant_mort |   -.006116   .0002611   -23.42   0.000     -.006632     -.0056
       _cons |   .8136375   .0120301    67.63   0.000     .7898632    .8374119
------------------------------------------------------------------------------
```

Figure 7. Multiple regression only significant against hdi (dependent) -150 obvs.

```
. regress hdi domsav infant_mort

      Source |       SS           df       MS      Number of obs   =        87
-------------+----------------------------------   F(2, 84)        =    153.04
       Model |  .828447122         2  .414223561   Prob > F        =    0.0000
    Residual |  .227362505        84  .002706696   R-squared       =    0.7847
-------------+----------------------------------   Adj R-squared   =    0.7795
       Total |  1.05580963        86  .012276856   Root MSE        =    .05203

------------------------------------------------------------------------------
         hdi |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      domsav |   .0019328   .0004595     4.21   0.000     .0010192    .0028465
 infant_mort |  -.0062365   .0004023   -15.50   0.000    -.0070366   -.0054364
       _cons |   .8253462   .0134674    61.28   0.000     .7985647    .8521277
------------------------------------------------------------------------------
```

Figure 8. *Multiple Regression of significant against hdi (dependent) - For F-Test (87 obvs.)*

```
. regress lgdpcap domsav infant_mort

      Source |       SS           df       MS      Number of obs   =        87
-------------+----------------------------------   F(2, 84)        =     62.16
       Model |  73.8831399         2  36.9415699   Prob > F        =    0.0000
    Residual |  49.9222838        84  .594312902   R-squared       =    0.5968
-------------+----------------------------------   Adj R-squared   =    0.5872
       Total |  123.805424        86  1.43959795   Root MSE        =    .77092

------------------------------------------------------------------------------
     lgdpcap |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      domsav |    .036188   .0068083     5.32   0.000      .022649    .0497269
 infant_mort |   -.049257   .0059619    -8.26   0.000    -.0611128   -.0374012
       _cons |   9.105598   .1995596    45.63   0.000     8.708752    9.502445
------------------------------------------------------------------------------
```

Figure *9. Multiple Regression of significant against hdi (dependent) - For F-Test (87 obvs.)*

```
. regress lgdpcap domsav domsavsq

      Source |       SS           df       MS      Number of obs   =       150
-------------+----------------------------------   F(2, 147)       =     46.19
       Model |  126.965941         2  63.4829705   Prob > F        =    0.0000
    Residual |   202.05677       147  1.37453585   R-squared       =    0.3859
-------------+----------------------------------   Adj R-squared   =    0.3775
       Total |  329.022711       149  2.20820611   Root MSE        =    1.1724

------------------------------------------------------------------------------
     lgdpcap |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      domsav |   .0511963   .0069236     7.39   0.000     .0375137    .0648788
    domsavsq |    .000248   .0001533     1.62   0.108    -.0000549     .000551
       _cons |   7.461719   .1496392    49.86   0.000     7.165997    7.757441
------------------------------------------------------------------------------
```

Figure 10. *Quadratic functional form regression of domsav against lgdpcap (dependent)*

```
. regress hdi domsav domsavsq

      Source |       SS           df       MS      Number of obs   =       150
-------------+----------------------------------   F(2, 147)       =     34.11
       Model |  1.23246049         2  .616230245   Prob > F        =    0.0000
    Residual |  2.65559108       147  .018065245   R-squared       =    0.3170
-------------+----------------------------------   Adj R-squared   =    0.3077
       Total |  3.88805157       149  .026094306   Root MSE        =    .13441

------------------------------------------------------------------------------
         hdi |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      domsav |    .005417   .0007937     6.82   0.000     .0038484    .0069856
    domsavsq |   .0000108   .0000176     0.62   0.539    -.0000239    .0000455
       _cons |    .596344   .0171549    34.76   0.000     .5624418    .6302461
------------------------------------------------------------------------------
```

Figure 11. *Quadratic functional form regression of domsav against hdi (dependent)*

. regress lgdpcap infant_mort infant_mortsq

Source	SS	df	MS			
Model	241.336192	2	120.668096	Number of obs	=	150
Residual	87.6865182	147	.596506926	F(2, 147)	=	202.29
Total	329.022711	149	2.20820611	Prob > F	=	0.0000
				R-squared	=	0.7335
				Adj R-squared	=	0.7299
				Root MSE	=	.77234

lgdpcap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
infant_mort	-.1224593	.0095015	-12.89	0.000	-.1412365	-.103682
infant_mortsq	.0009917	.0001307	7.59	0.000	.0007334	.0012499
_cons	10.41065	.1207332	86.23	0.000	10.17205	10.64925

Figure 12. *Quadratic functional form regression of infant_mort against lgdpcap (dependent)*

. regress hdi infant_mort infant_mortsq

Source	SS	df	MS			
Model	3.46770954	2	1.73385477	Number of obs	=	150
Residual	.420342037	147	.00285947	F(2, 147)	=	606.36
Total	3.88805157	149	.026094306	Prob > F	=	0.0000
				R-squared	=	0.8919
				Adj R-squared	=	0.8904
				Root MSE	=	.05347

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
infant_mort	-.0124154	.0006579	-18.87	0.000	-.0137154	-.0111153
infant_mortsq	.0000823	9.05e-06	9.09	0.000	.0000644	.0001001
_cons	.9096305	.0083591	108.82	0.000	.8931109	.9261501

Figure 13. *Quadratic functional form regression of infant_mort against hdi (dependent)*

. regress lgdpcap domsav infant_mort infant_mortsq developed

Source	SS	df	MS			
Model	280.036966	4	70.0092415	Number of obs	=	150
Residual	48.9857448	145	.337832723	F(4, 145)	=	207.23
Total	329.022711	149	2.20820611	Prob > F	=	0.0000
				R-squared	=	0.8511
				Adj R-squared	=	0.8470
				Root MSE	=	.58123

lgdpcap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
domsav	.020965	.0034603	6.06	0.000	.0141259	.0278041
infant_mort	-.0672043	.0094437	-7.12	0.000	-.0858694	-.0485393
infant_mortsq	.0004801	.0001177	4.08	0.000	.0002474	.0007129
developed	1.073946	.1500477	7.16	0.000	.7773823	1.370509
_cons	8.909049	.1679885	53.03	0.000	8.577027	9.241072

Figure 14. *Dummy Variable Developed added to model regressed against lgdpcap*

. regress hdi domsav infant_mort infant_mortsq developed

Source	SS	df	MS
Model	3.58760594	4	.896901485
Residual	.300445634	145	.002072039
Total	3.88805157	149	.026094306

Number of obs	=	150
F(4, 145)	=	432.86
Prob > F	=	0.0000
R-squared	=	0.9227
Adj R-squared	=	0.9206
Root MSE	=	.04552

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
domsav	.0013059	.000271	4.82	0.000	.0007703	.0018415
infant_mort	-.0095203	.0007396	-12.87	0.000	-.010982	-.0080585
infant_mortsq	.0000561	9.22e-06	6.08	0.000	.0000378	.0000743
developed	.0539639	.0117511	4.59	0.000	.0307383	.0771894
_cons	.8271908	.0131561	62.87	0.000	.8011883	.8531934

Figure 15. *Dummy Variable Developed added to model regressed against hdi*

. regress lgdpcap domsav infant_mort infant_mortsq if developed == 1

Source	SS	df	MS
Model	9.13504334	3	3.04501445
Residual	11.2717168	44	.256175383
Total	20.4067602	47	.434186387

Number of obs	=	48
F(3, 44)	=	11.89
Prob > F	=	0.0000
R-squared	=	0.4476
Adj R-squared	=	0.4100
Root MSE	=	.50614

lgdpcap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
domsav	.0278976	.006748	4.13	0.000	.0142979	.0414973
infant_mort	-.1545049	.0371763	-4.16	0.000	-.2294289	-.0795809
infant_mortsq	.0018592	.0005277	3.52	0.001	.0007957	.0029228
_cons	10.11751	.2414252	41.91	0.000	9.630954	10.60407

Figure 16. *Independent variables against lgdpcap using only developed country observations*

. regress hdi domsav infant_mort infant_mortsq if developed == 1

Source	SS	df	MS
Model	.124855791	3	.041618597
Residual	.044131213	44	.001002982
Total	.168987003	47	.003595468

Number of obs	=	48
F(3, 44)	=	41.49
Prob > F	=	0.0000
R-squared	=	0.7388
Adj R-squared	=	0.7210
Root MSE	=	.03167

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
domsav	.0008257	.0004222	1.96	0.057	-.0000252	.0016767
infant_mort	-.0145681	.0023262	-6.26	0.000	-.0192562	-.00988
infant_mortsq	.000138	.000033	4.18	0.000	.0000714	.0002045
_cons	.9138429	.0151064	60.49	0.000	.883398	.9442878

Figure 17. *Independent variables against hdi using only developed country observations*

```
. regress lgdpcap domsav infant_mort infant_mortsq if developed == 0
```

Source	SS	df	MS			
Model	71.3634624	3	23.7878208	Number of obs	=	102
Residual	35.3245014	98	.360454096	F(3, 98)	=	65.99
Total	106.687964	101	1.05631647	Prob > F	=	0.0000
				R-squared	=	0.6689
				Adj R-squared	=	0.6588
				Root MSE	=	.60038

lgdpcap	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
domsav	.0187872	.0040545	4.63	0.000	.0107411	.0268333
infant_mort	-.0652878	.0101423	-6.44	0.000	-.0854148	-.0451607
infant_mortsq	.0004377	.0001248	3.51	0.001	.0001901	.0006853
_cons	8.940148	.1869871	47.81	0.000	8.569078	9.311218

Figure 18. *Independent variables against lgdpcap using only developing country observations*

```
. regress hdi domsav infant_mort infant_mortsq if developed == 0
```

Source	SS	df	MS			
Model	1.50251424	3	.500838079	Number of obs	=	102
Residual	.246735979	98	.002517714	F(3, 98)	=	198.93
Total	1.74925022	101	.017319309	Prob > F	=	0.0000
				R-squared	=	0.8589
				Adj R-squared	=	0.8546
				Root MSE	=	.05018

hdi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
domsav	.0014065	.0003389	4.15	0.000	.000734	.0020789
infant_mort	-.009357	.0008476	-11.04	0.000	-.0110391	-.0076749
infant_mortsq	.0000537	.0000104	5.15	0.000	.000033	.0000744
_cons	.8240108	.0156275	52.73	0.000	.7929985	.8550231

Figure 19. *Independent variables against hdi using only developing country observations*

Part B: Countries Used in Data

Albania	Chad	France	Japan	Moldova	Poland	Sweden
Armenia	Chile	Germany	Kazakhstan	Mongolia	Portugal	Switzerland
Australia	China	Greece	Korea, Rep.	Montenegro	Qatar	Thailand
Austria	Colombia	Guatemala	Kyrgyz Republic	Morocco	Romania	Trinidad and Tobago
Barbados	Croatia	Honduras	Latvia	Netherlands	Russian Federation	Turkey
Belgium	Cyprus	Hungary	Lithuania	New Zealand	Saudi Arabia	Ukraine
Belize	Czech Republic	Iceland	Luxembourg	Nigeria	Serbia	United Kingdom
Bhutan	Denmark	India	Macedonia, FYR	Norway	Singapore	United States
Bosnia and Herzegovina	Dominican Republic	Indonesia	Madagascar	Pakistan	Slovak Republic	Uruguay
Brazil	Ecuador	Ireland	Malaysia	Panama	Slovenia	Vietnam
Bulgaria	Egypt, Arab Rep.	Israel	Malta	Paraguay	South Africa	
Bulgaria	Estonia	Italy	Mauritius	Peru	Spain	
Canada	Finland	Jamaica	Mexico	Philippines	Sri Lanka	

Figure 1: *List of 87 countries used in Models 1-4 and F-Test*

Afghanistan	Bhutan	China	Estonia	Haiti	Kenya	Malta	Nigeria	Senegal	Thailand
Albania	Bolivia	Colombia	Ethiopia	Honduras	Rep. Korea	Mauritania	Norway	Serbia	Togo
Algeria	Bosnia and Herzegovina	Dem. Rep. Congo	Fiji	Hungary	Kuwait	Mauritius	Oman	Sierra Leone	Tunisia
Angola	Botswana	Rep. Congo	Finland	Iceland	Kyrgyz Republic	Mexico	Pakistan	Singapore	Turkey
Argentina	Brazil	Cote d'Ivoire	France	India	Lao PDR	Moldova	Panama	Slovak Republic	Uganda
Armenia	Brunei Darussalam	Croatia	Gabon	Indonesia	Latvia	Mongolia	Paraguay	Slovenia	Ukraine
Australia	Bulgaria	Cuba	The Gambia	Islamic Rep. Iran	Lebanon	Montenegro	Peru	South Africa	United Arab Emirates
Austria	Burkina Faso	Cyprus	Georgia	Iraq	Lesotho	Morocco	Philippines	Sudan	United Kingdom
Azerbaijan	Burundi	Czech Republic	Germany	Ireland	Liberia	Mozambique	Poland	Spain	United States
Bahrain	Cambodia	Denmark	Ghana	Israel	Lithuania	Namibia	Portugal	Sri Lanka	Uruguay
Bangladesh	Cameroon	Dominican Republic	Greece	Italy	Luxembourg	Nepal	Qatar	Suriname	Uzbekistan
Belarus	Canada	Ecuador	Guatemala	Jamaica	Madagascar	Netherlands	Romania	Swaziland	Vietnam
Belgium	Central African Republic	Arab Rep. Egypt	Guinea	Japan	Malawi	New Zealand	Russian Federation	Sweden	Rep. Yemen
Belize	Chad	El Salvador	Guinea-Bissau	Jordan	Malaysia	Nicaragua	Rwanda	Switzerland	Zambia
Benin	Chile	Equatorial Guinea	Guyana	Kazakhstan	Mali	Niger	Saudi Arabia	Tanzania	Zimbabwe

Figure 2: *List of 150 countries used in Models 5 and 6 as well as functional form, and dummy variables*